

Duke University  
Edmund T. Pratt, Jr. School of Engineering

EE 61L Section 2, Fall 2001

**Test III**

Michael R. Gustafson II

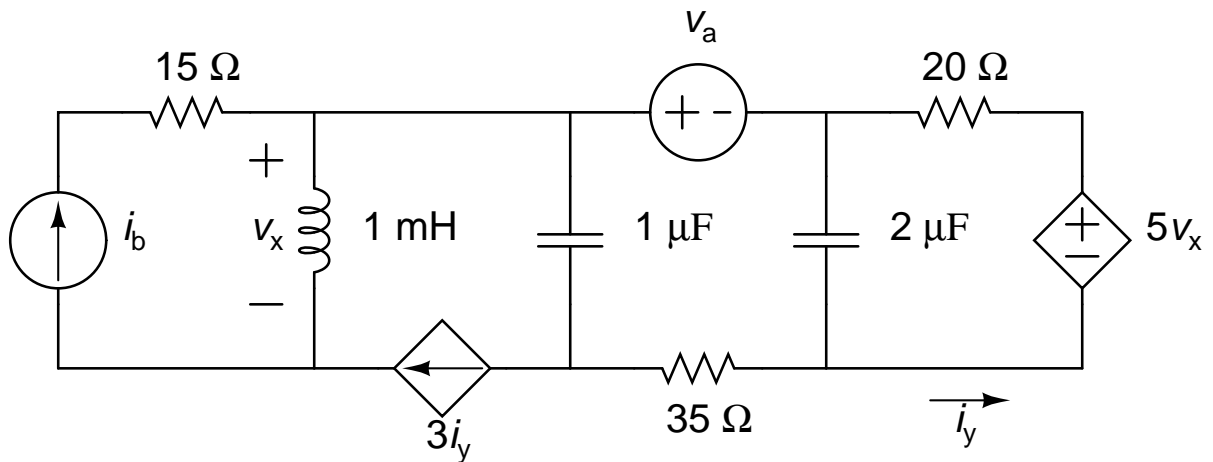
Name (please print) \_\_\_\_\_

In keeping with the Honor Code, I have neither provided nor received any assistance on this test. I understand if it is later determined that I gave or received assistance, I will fail the class and will be brought before the Undergraduate Judicial Board.

Signature: \_\_\_\_\_

**Problem I: [20 pts.] Phasor Representation**

Given the following circuit:

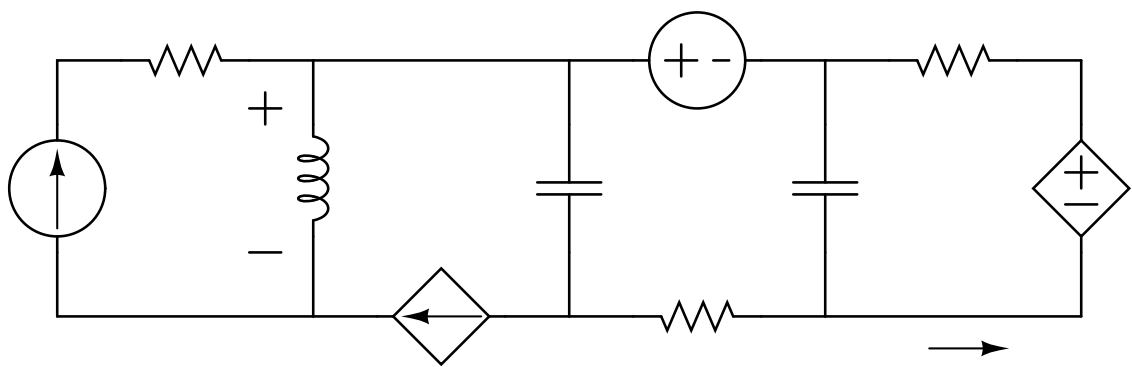


and the fact that:

$$v_a(t) = 2 \cos(32000t + 9^\circ) \text{ V}$$

$$i_b(t) = 3 \sin(32000t - 22^\circ) \text{ A}$$

draw the phasor representation. Make sure to convert **all possible components** and represent all impedances and independent sources numerically. Use the blank circuit template on the next page to present your answer.



Name (please print):

Honor Code (please initial):

## Problem II: [20 pts.] Complex Numbers

Given the following complex numbers:

$$\mathbb{A} = 8.485 \angle 45^\circ$$

$$\mathbb{B} = 2e^{j11\pi/6}$$

$$\mathbb{C} = 12 - j5$$

(1) Fill in the following chart:

	Real Part	Imag. Part	Magnitude	Angle (deg)	Angle (rad)
$\mathbb{A}$					
$\mathbb{B}$					
$\mathbb{C}$					

(2) Calculate the following:

(a)  $\mathbb{A}^* - \frac{\mathbb{B} + \mathbb{C}}{\mathbb{A}}$  in polar notation

(b)  $\frac{\mathbb{A}}{|\mathbb{A}|} + \frac{\mathbb{B}}{|\mathbb{B}|} + \frac{\mathbb{C}}{|\mathbb{C}|}$  in Euler notation

(c)  $\mathbb{A}\mathbb{C} - \mathbb{B}\mathbb{B}$  in Cartesian notation

Name (please print):

Honor Code (please initial):

**Problem III: [15 pts.] Differential Equations I**

Determine and *accurately plot* the solution to the following first-order initial condition problem:

$$5 \frac{dx(t)}{dt} + 2x(t) = 8$$
$$x(0) = 1$$

To get full credit, you must indicate construction lines for getting the values and slopes for three time constants.

Name (please print):

Honor Code (please initial):

**Problem IV: [15 pts.] Differential Equations II**

Determine the solution to the following first-order initial condition problem:

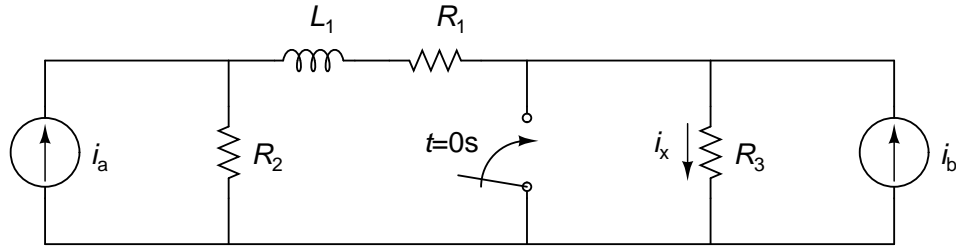
$$\begin{aligned}\frac{dy(t)}{dt} + 3y(t) &= 3e^{-3t} - 2e^{-2t} + 27t^2 \\ y(0) &= -4\end{aligned}$$

Name (please print):

Honor Code (please initial):

### Problem V: [30 pts.] Switched Circuits

Given the following circuit:



and known values

$$i_a = 1\text{mA}$$

$$i_b = -2\text{mA}$$

$$L_1 = 400\text{mH}$$

$$R_1 = 1\text{k}\Omega$$

$$R_2 = 1\text{k}\Omega$$

$$R_3 = 1\text{k}\Omega$$

solve for the value of the current  $i_x(t)$  for  $t > 0\text{s}$ . You must substitute numbers in for element and source values. Assume that the switch has been open for a very long time before it is closed. You do *not* have to graph the solution. *Hint 1:* Remember that you will want to solve in terms of the state variable first, then relate the state variable to your unknown later. *Hint 2:* You should have a first-order differential equation with a constant forcing function; you should also be able to easily determine the initial and final values of the state variable.